

# CARB Fuels Workshop

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# Topics

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- Sulfur/NO<sub>x</sub> relationship in Predictive Model
- Sulfur Cap

# Sulfur/NOx Response in Predictive Model Needs to be Fixed

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- WSPA Presentation at January 26 Fuels Workshop
  - Draft model does not fit the available data
  - Caused by exclusion of studies from Tech 5 offset terms
    - Included: CRC\_E60 and AAMSUOXY
    - Excluded: CRCLOSUL, CRCLOSUO and AAMALOSU

# Comments Received at Workshop

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- Advanced technology vehicles are more sensitive to sulfur
- Advanced technology is better represented in more recent studies
- Studies that did not include fuel sulfur <30 ppm should not be extrapolated

Are these claims valid?

## **Comment 1**: Advanced Technology Vehicles Are More Sensitive to Sulfur

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- Some tendency for an increase in the average slope for lower emitting vehicles
- Many low emitting vehicles were relatively insensitive
- The greatest sensitivities were observed for relatively high emitting vehicles

**Conclusion:** While there are some very low emitting vehicles that are more sensitive, there are others that are not. The range of sulfur sensitivities is represented in all Tech 5 studies, not just the studies selected by ARB.

## **Comment 2: Advanced Technology Vehicles Are Better Represented in More Recent Studies**

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- All Tech 5 studies examined vehicles of similar certification levels
- Model years spanned a narrow range
  - (1997 – 2001)
- Base emission levels were similar across most studies

**Conclusion: No evidence of enhanced representation of advanced vehicles in the studies selected by ARB**

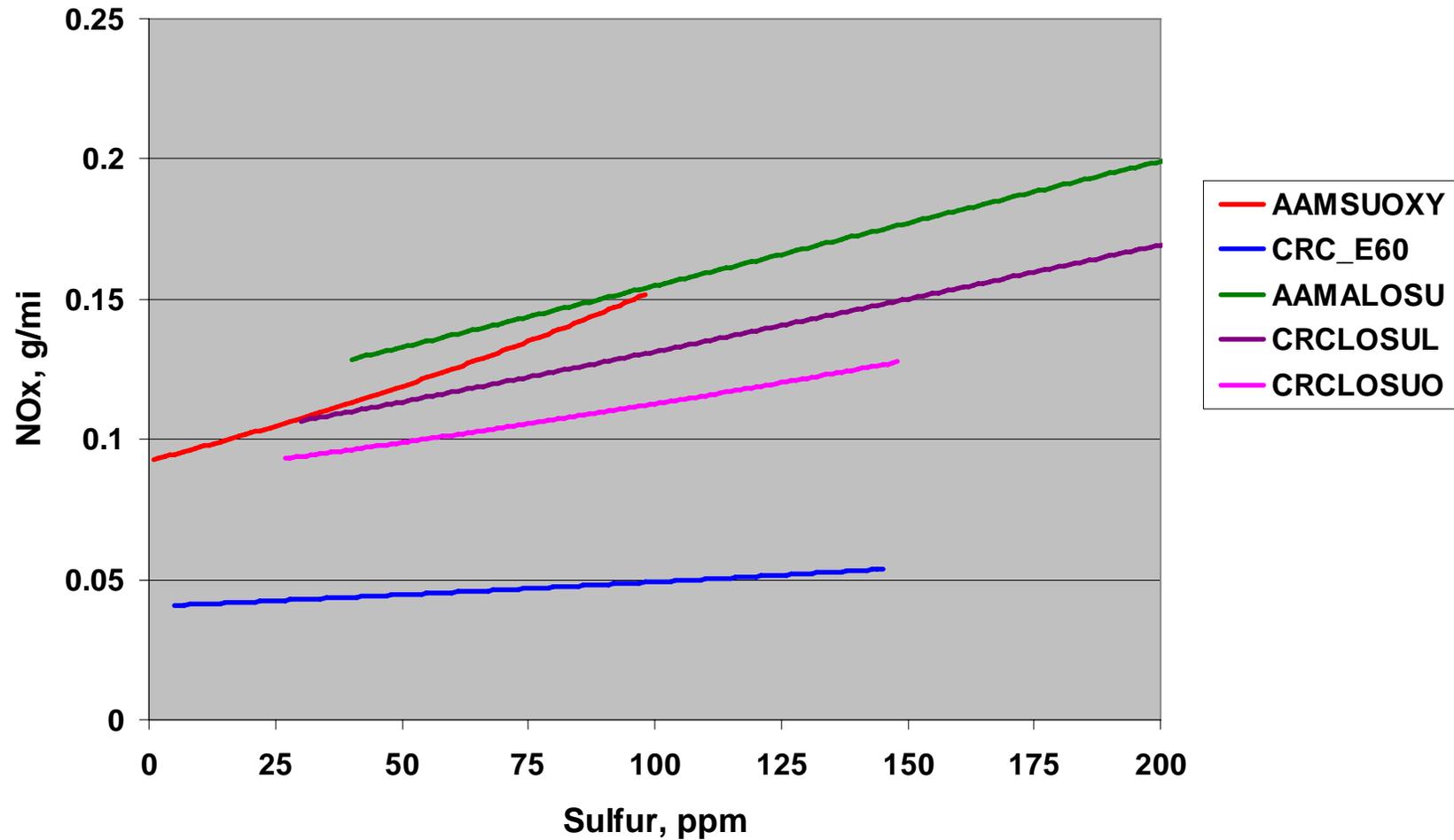
## **Comment 3: Extrapolation of Sulfur Data is Inappropriate**

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- Studies chosen by ARB are linear from 0 to 100-150 ppm sulfur
- Studies excluded by ARB include data down to 27-40 ppm sulfur
- No indication that extrapolation from 27-40 ppm to 0 ppm is inappropriate
- Extrapolation used for other fuel properties

**Conclusion: No justification for exclusion of data on the basis of the sulfur range of the study.**

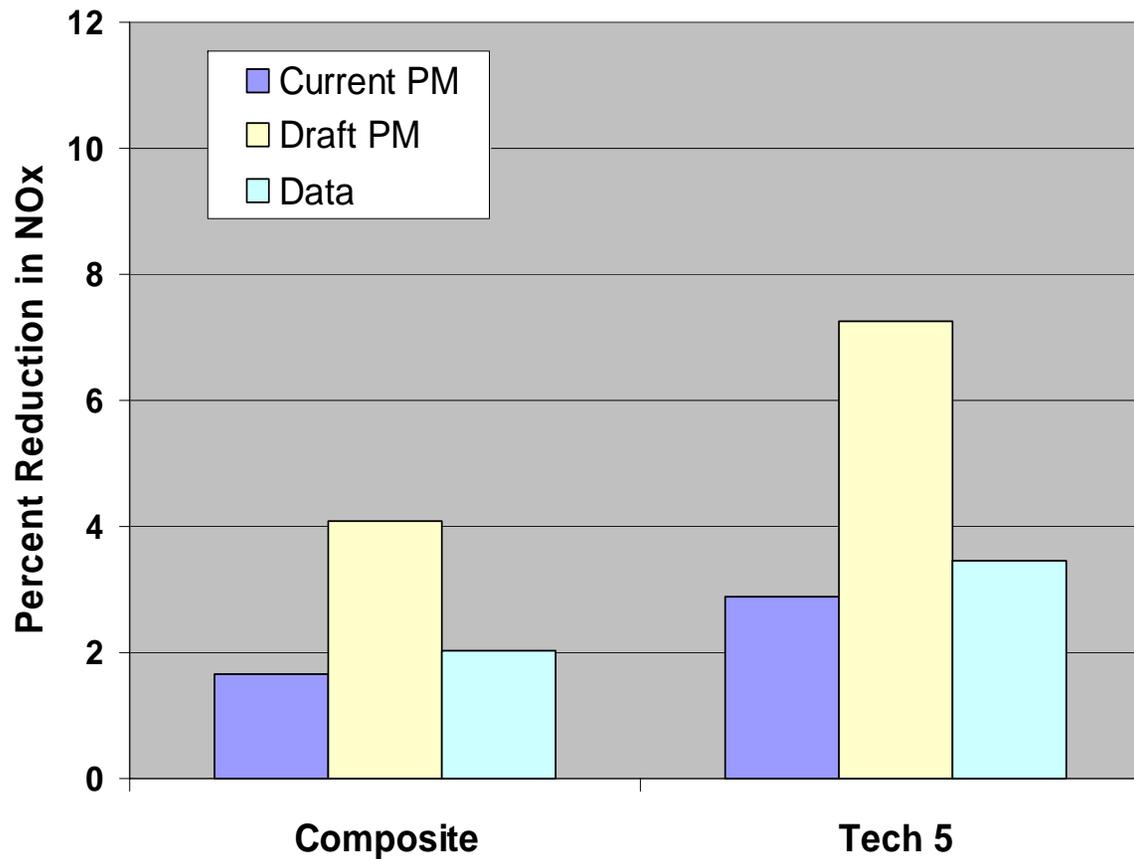
# Summary of Sulfur/NO<sub>x</sub> Studies



# Comparison of Models with Data

## NOx Reduction: 20→10 ppm Sulfur

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# WSPA Opposes Reducing Sulfur Cap from 30 ppm to 20 ppm

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- Reduces flexibility and producibility
- No emissions benefit
- Vehicles don't need it

# 20 ppm Sulfur Cap Will Reduce Flexibility and Producibility

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- Reduces blending flexibility
  - Restricts the number of blends that are available to produce complying gasoline
  - Sulfur levels between 20-30 ppm will not be legal in emergencies, e.g. if refinery process units are down
    - + Reblending off-spec batches is even harder with steep S/NO<sub>x</sub> response
  - Certain crudes and blending components may not be usable
- Reduced producibility a natural consequence of limited flexibility
  - Volumetric impact hard to predict, may be sporadic
- Survey data indicate that few retail samples are above 20 ppm
  - Significant mixing probably occurs in fungible distribution system

# 20 ppm Sulfur Cap Will Not Reduce Emissions

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- Gasoline blenders need to meet the emission requirements as defined by the Predictive Model
- Cap does not impact the equations, just the possible compositions available for complying blends
- Forcing lower sulfur levels is counter to principal of setting a performance standard and letting producers meet it at lowest cost

# Today's New Vehicles Don't Need Lower Sulfur

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- Current new and in-use vehicles are meeting emission standards at today's sulfur levels
  - Lower sulfur will reduce OEM costs to meet vehicle emission standards; need to compare vehicle savings vs. higher fuel costs
  - Lower sulfur could reduce emissions if combined with new emission standards and certification fuel
- Lean-burn engines might require lower sulfur levels, but ...
  - Very few are being built, even outside US
  - No data on ability of lean-burn engines to meet California emission standards
  - If large scale production of lean-burn engines is planned, data should be developed by CRC on sulfur sensitivity

# Summary

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- There is limited ability to further reduce emissions without a potential negative effect on producibility
- The new predictive model requires significant emissions reductions to offset permeation, and in and of itself, has a potential negative impact on producibility
- A scientifically sound NOx model may have a further negative impact on producibility (applies to ethanol contents above 5.7%)
- Reducing the sulfur cap further constrains producibility
- WSPA commits to work with CARB to develop a comprehensive plan that addresses state renewable fuel initiatives and their emissions impacts

Questions?

# Backup Charts

# **Comment 1: Advanced Technology Vehicles Are More Sensitive to Sulfur**

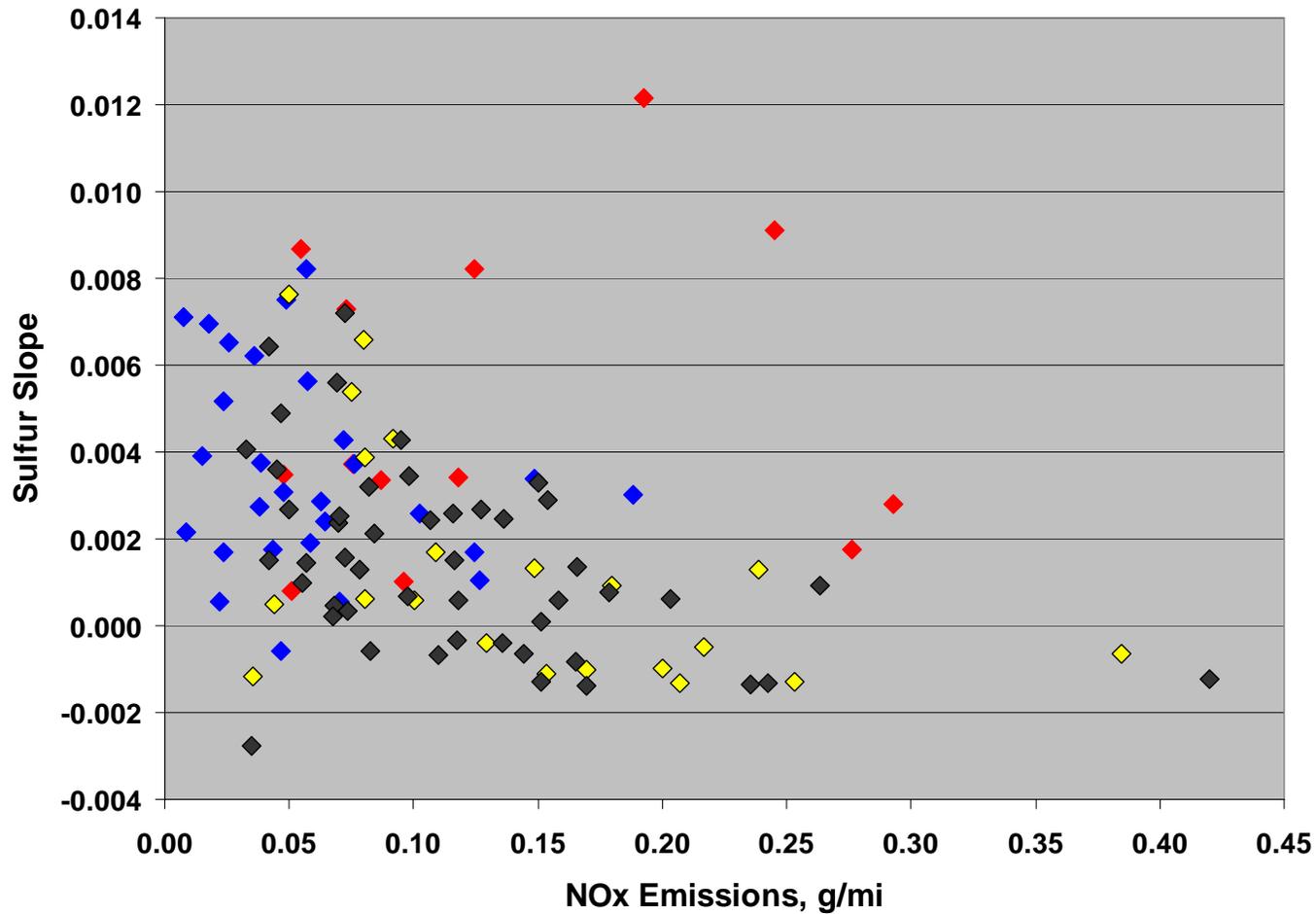
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Analysis: Examine slope vs. emissions level for individual vehicles (CARB definition)

- Emissions level
  - + Related to certification category
    - TLEV: 0.4 g/mi
    - LEV & ULEV: 0.2 g/mi
  - + Observed NOx emissions on 27-40 ppm fuel
- Slope
  - + Fixed effect model for each study
  - + CRC\_E60, AAMSUOXY, CRCLOSUO linear
  - + CRCLOSUL, AAMALOSU linearized (0-30 ppm)

# Advanced technology differences? Slope vs. Emissions Level

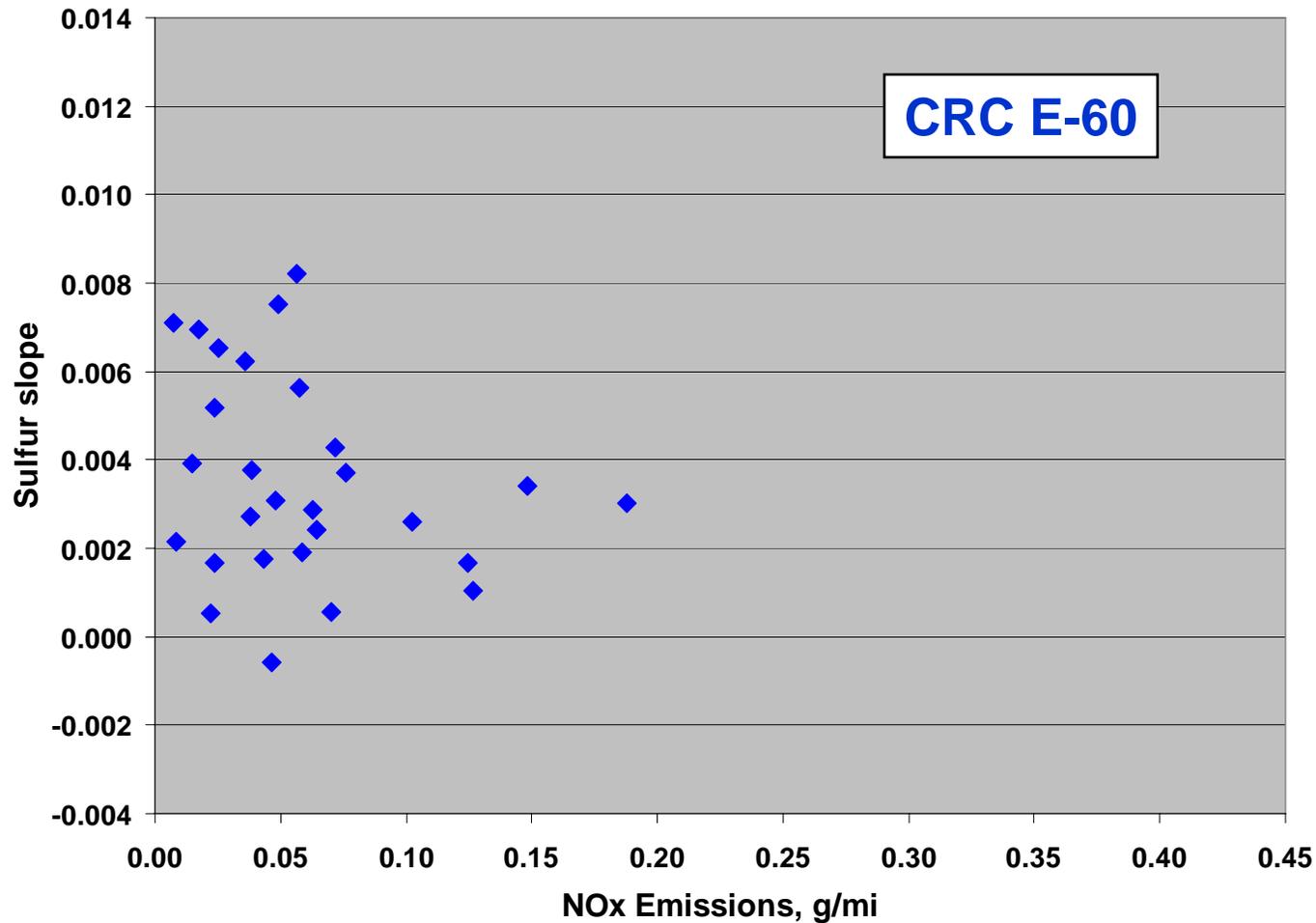
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# Advanced technology differences?

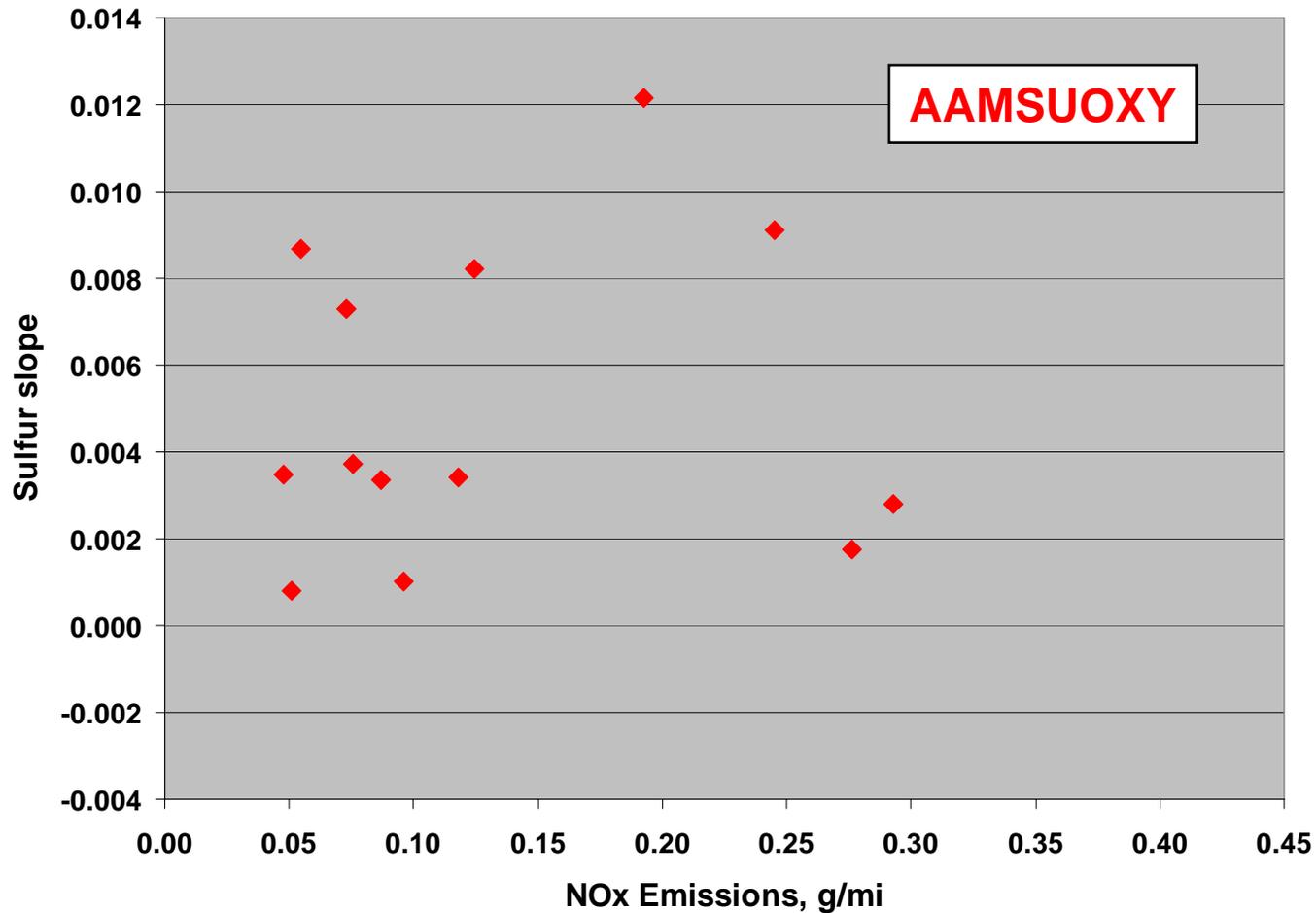
## Slope vs. Emissions Level

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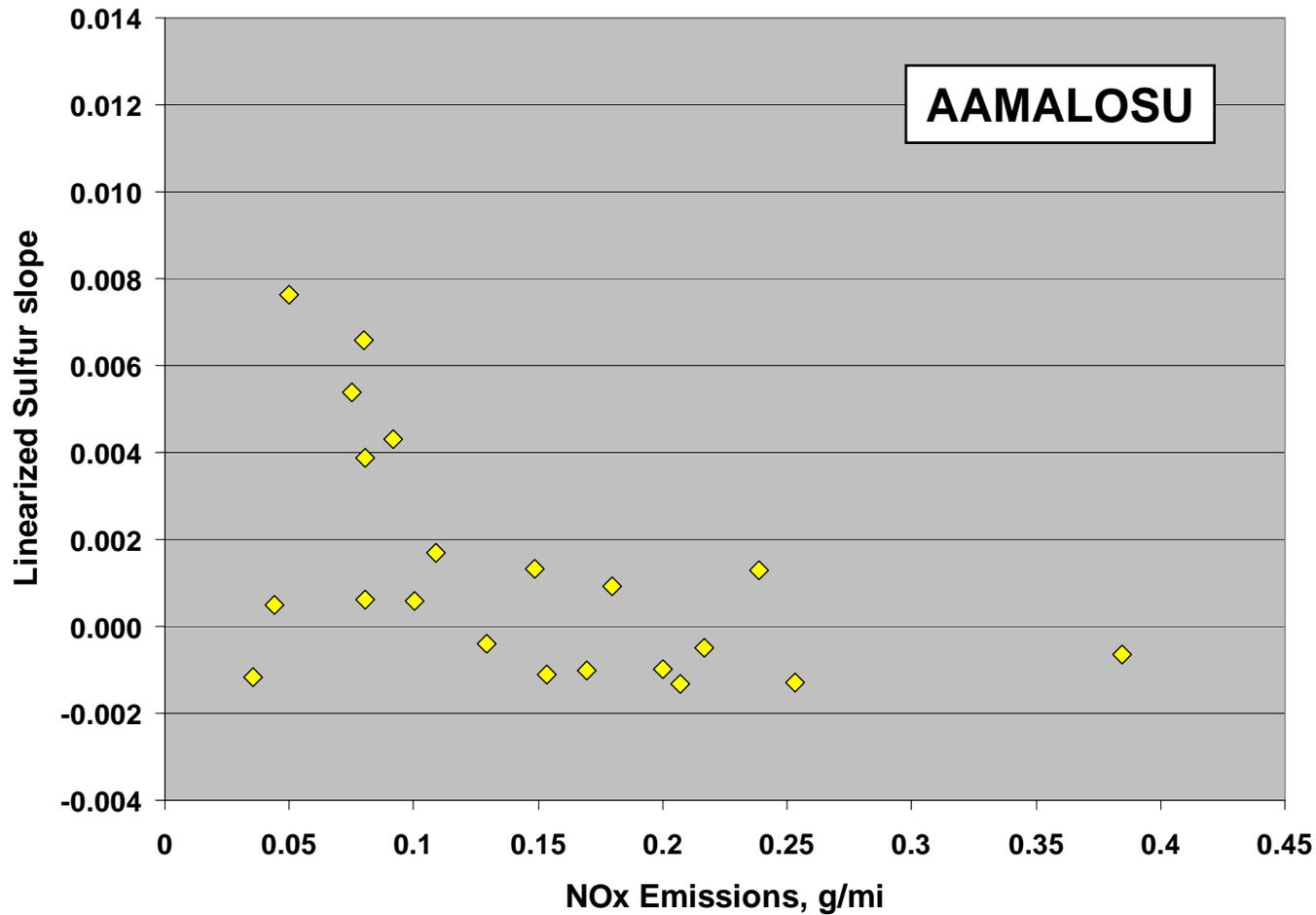
# Advanced technology differences? Slope vs. Emissions Level

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# Advanced technology differences? Slope vs. Emissions Level

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## **Comment 2: Advanced Technology Vehicles Are Better Represented in More Recent Studies**

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- **CRC E-60**
  - 2000-2001 MY vehicles
  - LEV, ULEV, SULEV, Euro 3
- **AAMSUOXY**
  - Vehicle model years unknown (Study completed in 1999)
  - Vehicle technologies unknown
- **CRC LEV (CRCLOSUL and CRCLOSUO)**
  - 1997 model year vehicles
  - LEV
- **AAMALOSU**
  - 1997-1999 MY vehicles
  - TLEV (1), LEV, ULEV, PULEV

## Comment 2: Advanced Technology Vehicles Are Better Represented in More Recent Studies

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Study	Percent of Vehicles with Emissions <0.1 g/mi
CRC_E60	82.1%
AAMSUOXY	53.8%
CRCLOSUL	50.0%
CRCLOSUO	50.0%
AAMALOSU	38.1%

## **Comment 3: Extrapolation of Sulfur Data is Inappropriate**

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- Such extrapolation required for Tech 3 & 4
- The two studies that do not require extrapolation have only one level within range
- The other studies have data in range of 27 – 40 ppm
- All studies include the range from 40 to 100 ppm